$1.00

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OPERATOR'S MANUAL

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

NCR 4600-2 (dB)
DIGITAL VOLT-OHM-MILLIAMMETER

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260
In Canada, Bach-Simpson, Ltd., London, Ontario

OPERATOR'S MANUAL

(Supplement to Simpson 460-2 Operator's Manual)

NCR 4600-2 (dB) DIGITAL VOLT-OHM-MILLIAMMETER

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Printed in U.S.A.
9-74 HINZ 550

Part No. 5-116602

Figure 1-1. NCR 4600-2 (dB) Digital Volt-Ohm-Milliammeter

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SECTION I

INTRODUCTION

1.1 GENERAL

1.1.1 This Operator's Manual, NCR 4600-2 (dB) Digital Volt-Ohm-Milliammeter, is a supplement to the Simpson 460-2 Operator's Manual. It contains detailed operating instructions, specifications, theory, and circuit description of the dB function of the NCR 4600-2. All other functions and characteristics of the NCR 4600-2 are identical to the Simpson 460-2 and their operating instructions are fully described in the Simpson 460-2 Operator's Manual. Therefore, it is essential that the operator review and become thoroughly familiar with the technical information contained in the Simpson 460-2 Operator's Manual, then proceed to read this manual.

1.1.2 The NCR 4600-2 (see Figure 1-1), has the full functional range of the Simpson 460-2 plus the capability of displaying AC voltages in terms of decibels. dB measurement of various signal strengths expands the usefullness of the NCR 4600-2 in the field of telephone communications. With the addition of a logarithmic converter, the NCR 4600-2 measures and displays directly AC voltages from −60 dB to +58 dB in five ranges. The dB readings are referenced to 0 dB power level of 1 milliwatt into a 600 ohms load, or 0.775 VAC across 600 ohms. Measurements are based upon average sensing and calibrated in terms of the RMS value of a sine wave.

1.2 TECHNICAL DATA

Table 1-1 lists the technical specifications for the dB function of the NCR 4600-2 Digital Volt-Ohm-Milliammeter.

Table 1-1. Technical Data

1. dB RANGES AND CHARACTERISTICS:

Range (dB)	Accuracy*	Input Impedance	Overload Protected To
−60 to −40	±20% ±1 digit	1MΩ, 150 pF	+53 dB (350V)
−40 to −20	±10% ±1 digit	1MΩ, 150 pF	+53 dB (350V)
−20 to 0	±10% ±1 digit	1MΩ, 150 pF	+53 dB (350V)
0 to +20	±10% ±1 digit	1MΩ, 150 pF	+58 dB (600V)
+20 to +40	±10% ±1 digit	1MΩ, 150 pF	+58 dB (600V)
+40 to +58	±10% ±1 digit	1MΩ, 150 pF	+58 dB (600V)

2. 0 dB REFERENCE: 1 milliwatt into 600Ω.

3. FREQUENCY RANGE: 100 Hz to 5 kHz

4. RESOLUTION: 0.1 dB

5. RESPONSE TIME: 5 seconds maximum (to rated accuracy)

*Figures refer to % of input signal.

SECTION II

OPERATION

WARNING

Review and comply with WARNING and SAFETY PRECAUTIONS listed in paragraphs 4.1 and 4.2 in Section IV of the Simpson 460-2 Operator's Manual. Do not attempt to operate the NCR 4600-2 before becoming familiar with these instructions.

2.1 dB MEASUREMENT

a. Review and comply with the Preliminary Notes and Checks, paragraph 4.3 of the Simpson 460-2 Operator's Manual.

b. Connect input leads to the V-Ω-dB and COMMON input jacks.

c. Turn the function selector switch (see Figure 2-1) to the ACV dB position.

d. Depress the PUSH IN FOR dB (ACV) switch to the "in" position.

e. Refer to Table 2-1 and set the range selector switch to the appropriate position. If the signal level being measured is unknown, begin with the range selector switch set to the 600 VAC position (+58 dB).

CAUTION

Do not attempt to measure a voltage on the 600 VAC range which might be greater than 600 volts (+58 dB).

f. Remove all power from the circuit being measured and discharge all capacitors.

g. Connect test leads to the circuit being measured.

h. Apply power to the circuit being measured. The dB value of the voltage being measured will be indicated on the numerical display. The NCR 4600-2 automatically will indicate the correct polarity.

NOTE: The ANALOG READOUT is not functional in the dB mode of operation.

i. Remove all power from the circuit being measured and discharge all capacitors prior to disconnecting test leads.

j. Depress the PUSH IN FOR dB (ACV) switch and release to the "out" position when the dB function is no longer required.

Table 2-1. dB Measurement Ranges and Connections

Range	Range Switch Position	Function Switch Position	Input Connections	Max. Voltage	Remarks
−60 to −20 dB	200 mV	ACV (dB)	V-Ω-dB COMMON	+53 dB (350V)	
−20 to 0 dB	2	ACV (dB)	V-Ω-dB COMMON	+53 dB (350V)	
0 to +20 dB	20	ACV (dB)	V-Ω-dB COMMON	+58 dB (600V)	Frequency Range: 100 Hz to 5 kHz for all range positions.
+20 to +40 dB	200	ACV (dB)	V-Ω-dB COMMON	+58 dB (600V)	
+40 to +58 dB	600 VAC	ACV (dB)	V-Ω-dB COMMON	+58 dB (600V)	

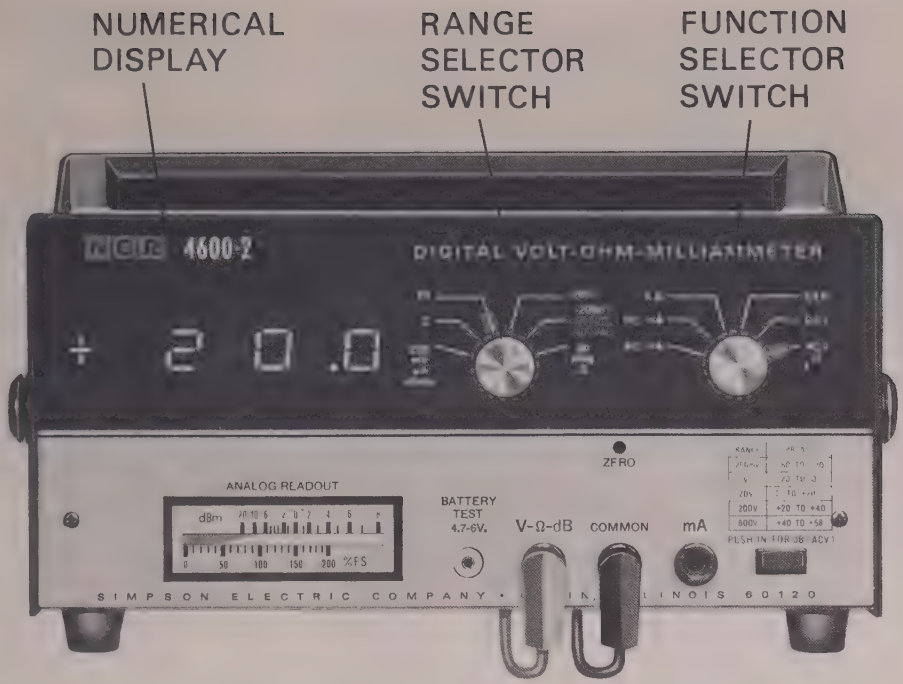

Figure 2-1. NCR 4600-2, Front View

SECTION III

THEORY OF OPERATION

3.1 THEORY

3.1.1 In telephone communication, it is useful to appraise signal strengths in terms of relative loudness as registered by the ear. A peculiarity of the ear is that an increase or decrease in loudness is directly responsive to the ratio of the amounts of power involved. Furthermore, the response to change in sound strength is practically independent of absolute value of the power. In other words, the human ear has a logarithmic response. This fact is the basis for the use of the relative-power unit called the decibel (dB).

3.1.2 The number of decibels corresponding to a given power ratio is given by the following formula:

$$dB = 10 \log \frac{P_1}{P_2}$$

Voltage or current ratios can be used, but only when the impedance is the same for both values of voltage or current. Under this condition, the decibel relationship with voltage is given by the following formula:

$$dB = 20 \log \frac{V_1}{V_2}$$

3.1.3 As common in telephone communication, the dB function of the NCR 4600-2 is designed for audio level measurements in terms of decibels, using one milliwatt of power as a reference. Specifically, the dB function is based upon the following equation:

$$dB = 20 \log \frac{V}{0.775}$$

where V is the input voltage being measured. The factor 0.775 is the reference voltage value based on dissipating one milliwatt of power into a 600 ohms load.

3.1.4 For decibel measurements on circuits with resistance other than 600 ohms, apply the proper correction factor to the 4600-2 reading by the following formula:

$$\Delta dB = -10 \log \frac{R}{600}$$

where R is the resistance of the circuit being measured. For example, algebraically add correction factor $-10 \log \frac{900}{600}$ or -1.76 dB to the 4600-2 reading for measurements on a 900 ohm circuit.

3.2 dB MEASURING CIRCUIT DESCRIPTION

3.2.1 The AC voltage being measured is connected to the V-Ω-dB and COMMON jacks and applied directly to a frequency compensated attenuator (see Figure 3-1). The test voltage is thereby attenuated according to the range selected and applied to an Input Amplifier. The output of the Input Amplifier is then applied to an AC to DC converter which converts the amplified voltage into a DC voltage by a precision operational rectifier. (For detailed circuit description of the AC to DC Converter, refer to paragraphs 5.2.3 through 5.2.8 of the Simpson 460-2 Operator's Manual.)

3.2.2 The DC voltage generated by the AC to DC converter is then applied to the Log Converter through a filter network and the dB pushbutton switch. The Log Amplifier in turn converts the applied DC voltage into a logarithmic signal.

3.2.3 After attenuation and offset (according to the range selected) the resulting logarithmic voltage is measured by the DC Digital Voltmeter. The indication on the Numerical Display is equal to the dB value of the input AC voltage being measured. The decimal point is fixed for 0.1 dB resolution. The polarity of the decibel value is automatically indicated with a "+" or "−" sign.

3.3 LOG CONVERTER

3.3.1 The Log Converter consists of a Voltage Follower, a monolithic Log Amplifier, and Scale Offset Adjustment circuitry.

3.3.2 The operational amplifier Voltage Follower transforms the high impedance output of the AC to DC Converter into a low impedance signal to the Log Amplifier. The variable resistor connected to the "−" input of the operational amplifier is used for offset voltage adjustment.

3.3.3 Operation of the monolithic Log Amplifier is based upon the exponential relationship between the collector current and the base-emitter voltage of a transistor. The Log Amplifier is capable of handling three decades of voltage input. It is fully temperature compensated and is designed to provide one volt of output for each decade change of input.

3.3.4 In conjunction with the current from a constant current source, the Scale Offset Adjustment circuitry supplies the appropriate offset voltage as required by the range selected.

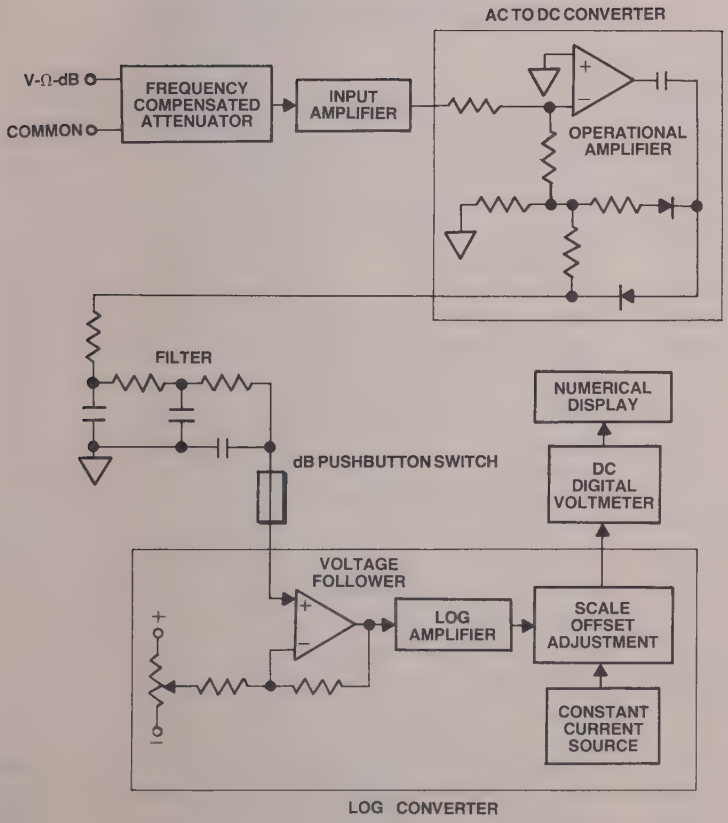

Figure 3-1. Block Diagram

SECTION IV

NCR 4600-2 dB FUNCTION

REPLACEMENT PARTS LIST

Reference Symbol	Description	Part No.
C201	Capacitor, 91 pF ±5%, 300V S.M.	5-115541
C202	Capacitor, 150 pF ±5%, 63V Polystyrene	5-115777
C203	Capacitor, .1 μF 20V Ceramic Disc	5-114521
D201	Diode, Zener Ref., 6.4V ±5%	5-116201
IC201	I.C. Oper. Amplifier	5-116598
IC202	I.C. Log Amplifier	5-117699
R201	Resistor, 10k Ω ±10%, 1/4W	5-113624
R202	Resistor, 1 MΩeg. ±1%, 1/4W	5-117693
R203	Pot, 100k Ω ±10%, Cermet	5-117692
R204	Resistor, 1k Ω ±1%, 1/4W	5-115490
R205	Resistor, 10k Ω ±1%, 1/4W	5-114962
R206	Resistor, 10k Ω ±1%, 1/4W	5-114962
R207	Resistor, 1.4k Ω ±1%, 1/4W	5-117697
R208	Pot, 2kΩ ±10%, Cermet	5-117691
R209	Resistor, 665Ω ±1%, 1/4W	5-117698
R210	Pot, 1kΩ ±10%, Cermet	5-116185
R211	Resistor, 604kΩ ±1%, 1/4W	5-117694
R212	Pot, 2kΩ ±10%, Cermet	5-117691
R213	Resistor, 4kΩ ±1%, 1/4W	5-117697
R214	Resistor, 3.4kΩ ±1%, 1/4W	5-117696
R215	Pot, 2kΩ ±10%, Cermet	5-117691
R216	Resistor, 1kΩ ±1%, 1/4W	5-115490
R217	Resistor, 1kΩ ±1%, 1/4W	5-115490
R218	Pot, 1k Ω ±10%, Cermet	5-116185
R219	Resistor, 402Ω ±1%, 1/4W	5-116772
R220	Resistor, 402Ω ±1%, 1/4W	5-116772
R221	Resistor, 402Ω ±1%, 1/4W	5-116772
R222	Resistor, 402Ω ±1%, 1/4W	5-116772

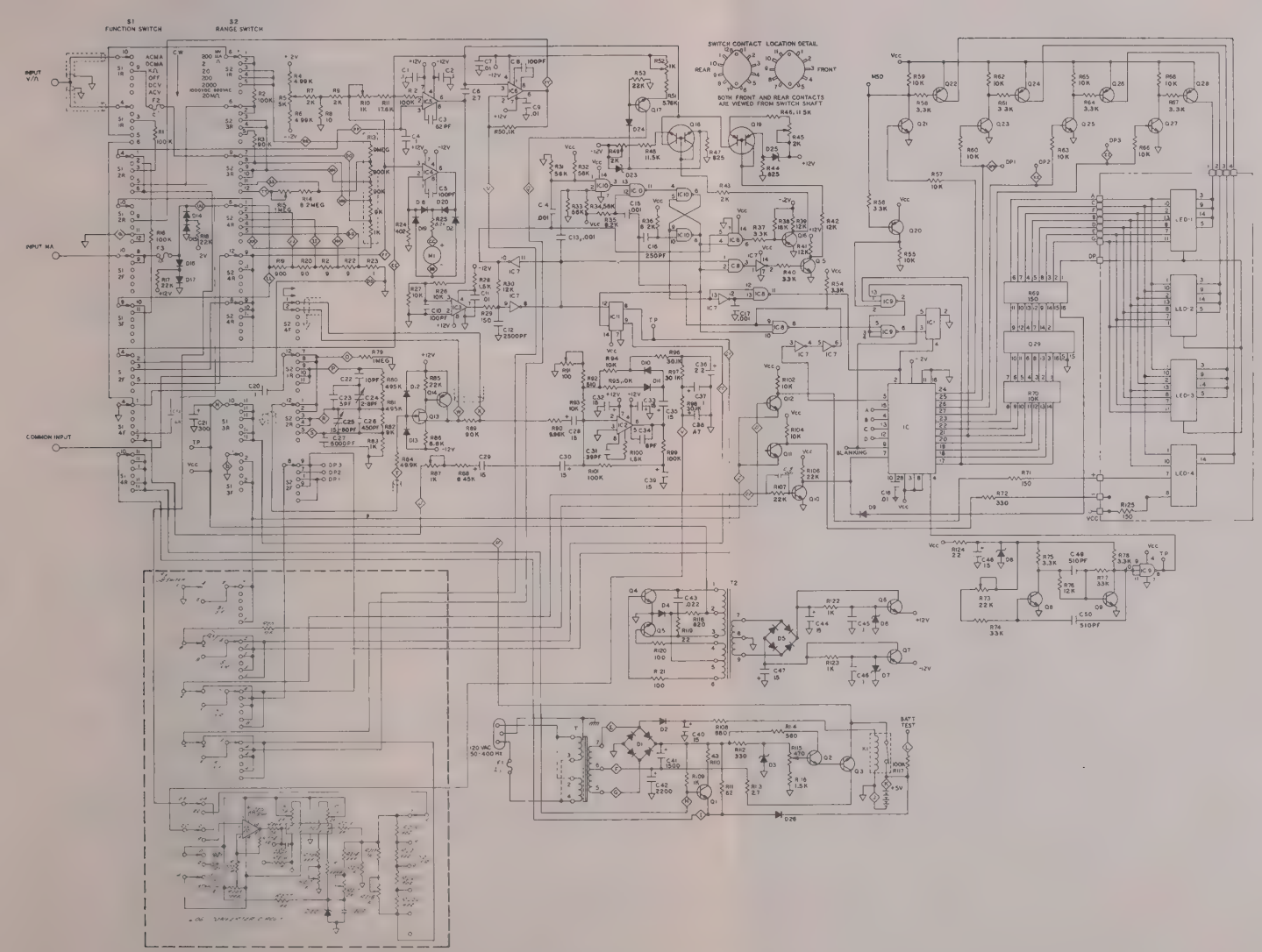

Figure 4-1. Schematic Diagram

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